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(54) Exhaust brake relief valve has hardened seat and insulated spring

(57) Exhaust brake 22 has a butterfly 7 hinged at 8 within a casing 23, and activated by a fluid actuator (20, fig. 2). Relief valve 24 has a casing 25, secured to casing 23 by bolts 40. This construction allows valve seat 28 and valve 29 to be made from harder materials (Fe-Cr-Mo sintered alloy and stainless steel respectively, both hardened to 1000-1200 Vickers Hv) than the cast iron used for easing 23. Spring 31 is insulated from the hot exhaust gases, which could soften it, by seals 30 and bush 60 on valve shaft 29a. Further insulation is provided by adiabatic gaskets. The spring is located within chamber 32, and may be adjusted to control the relief pressure by screw 33, which has a locknut fitted. Fig. 6 shows an alternative embodiment, using an engine exhaust valve and associated components to cut costs. Figs. 7 and 8 show prior art.

FIG.1

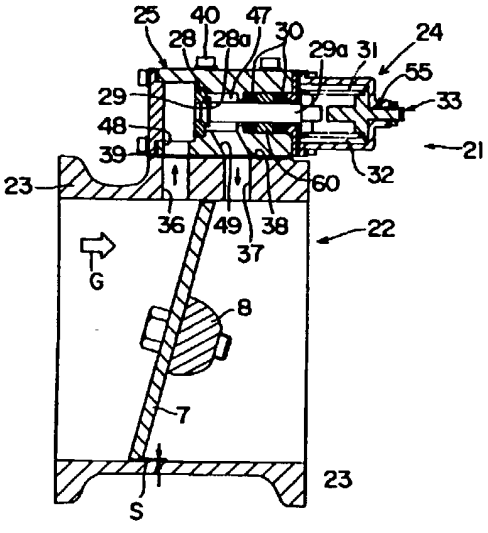

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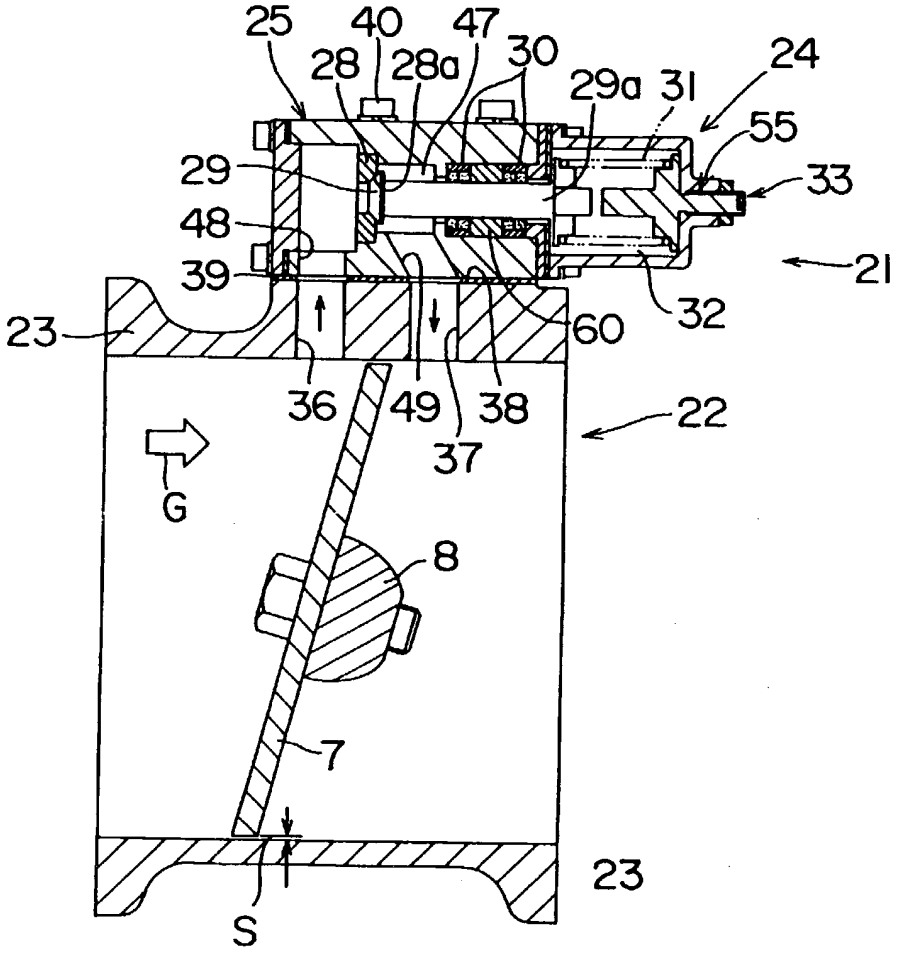
FIG.1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S

FIG.2

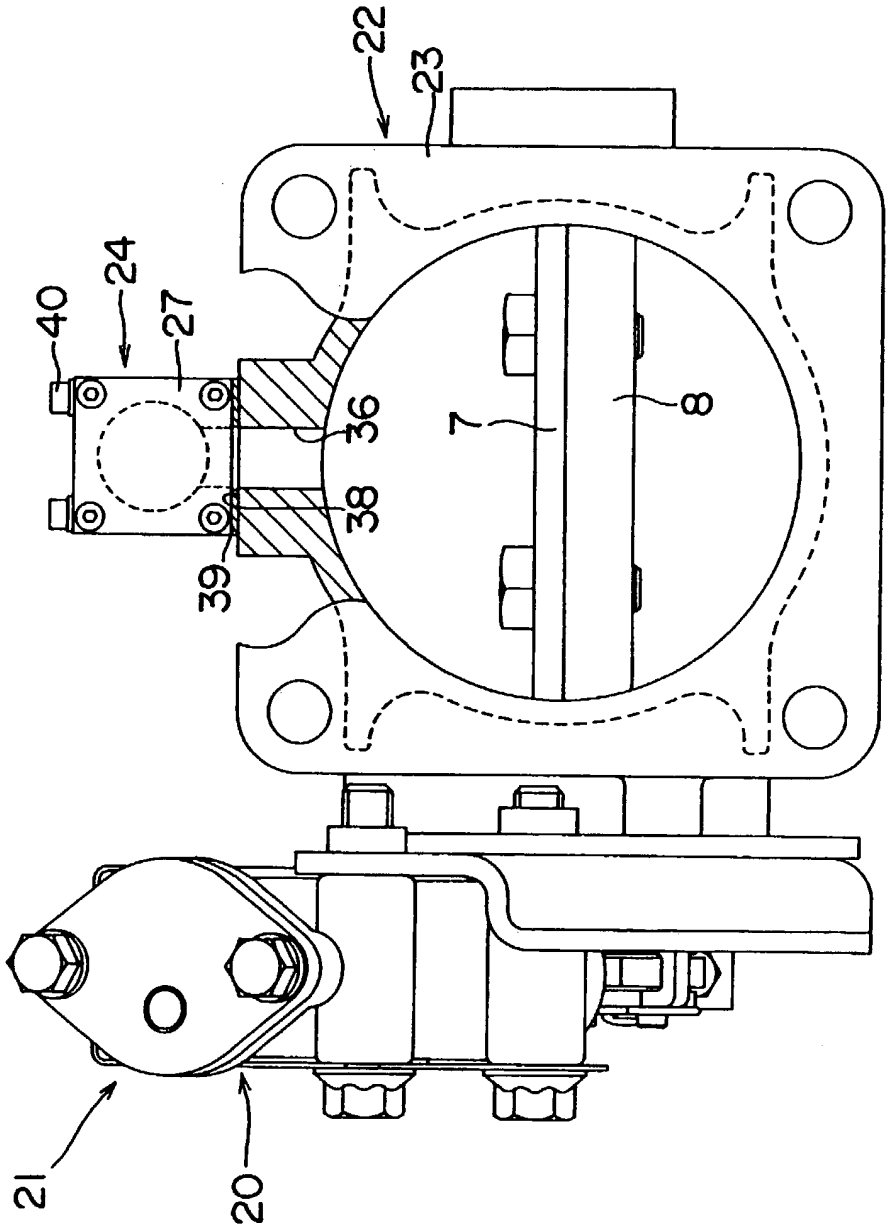

FIG. 3

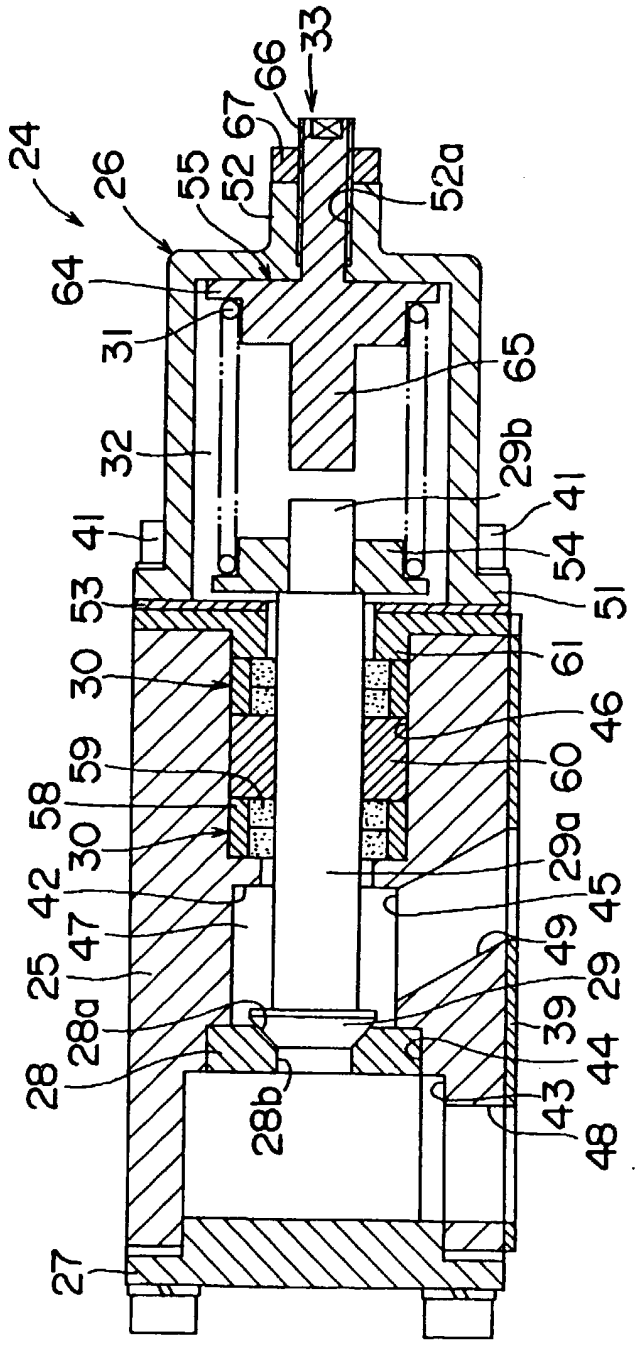
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FIG.4

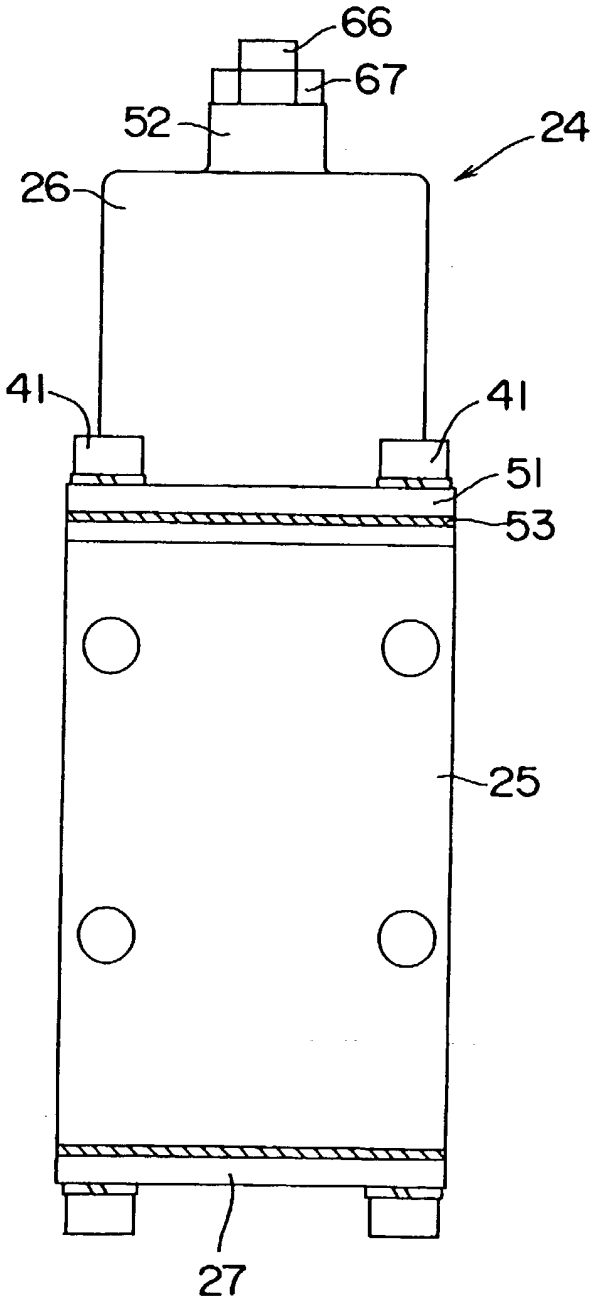

FIG.5

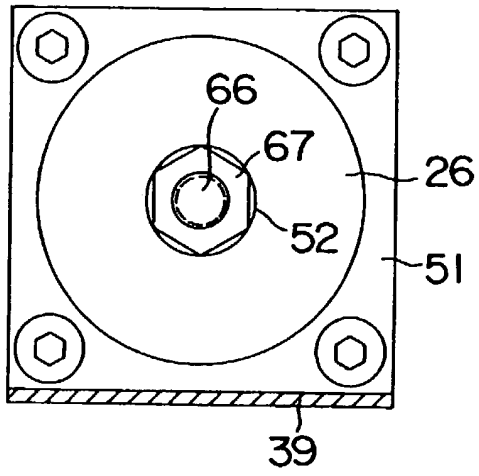
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FIG.6

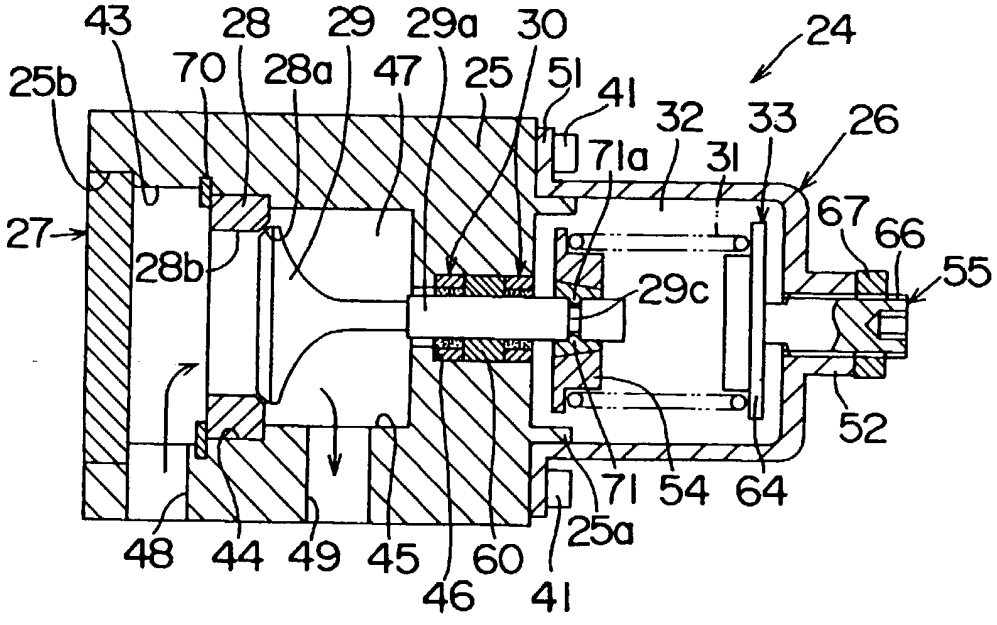
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FIG.7

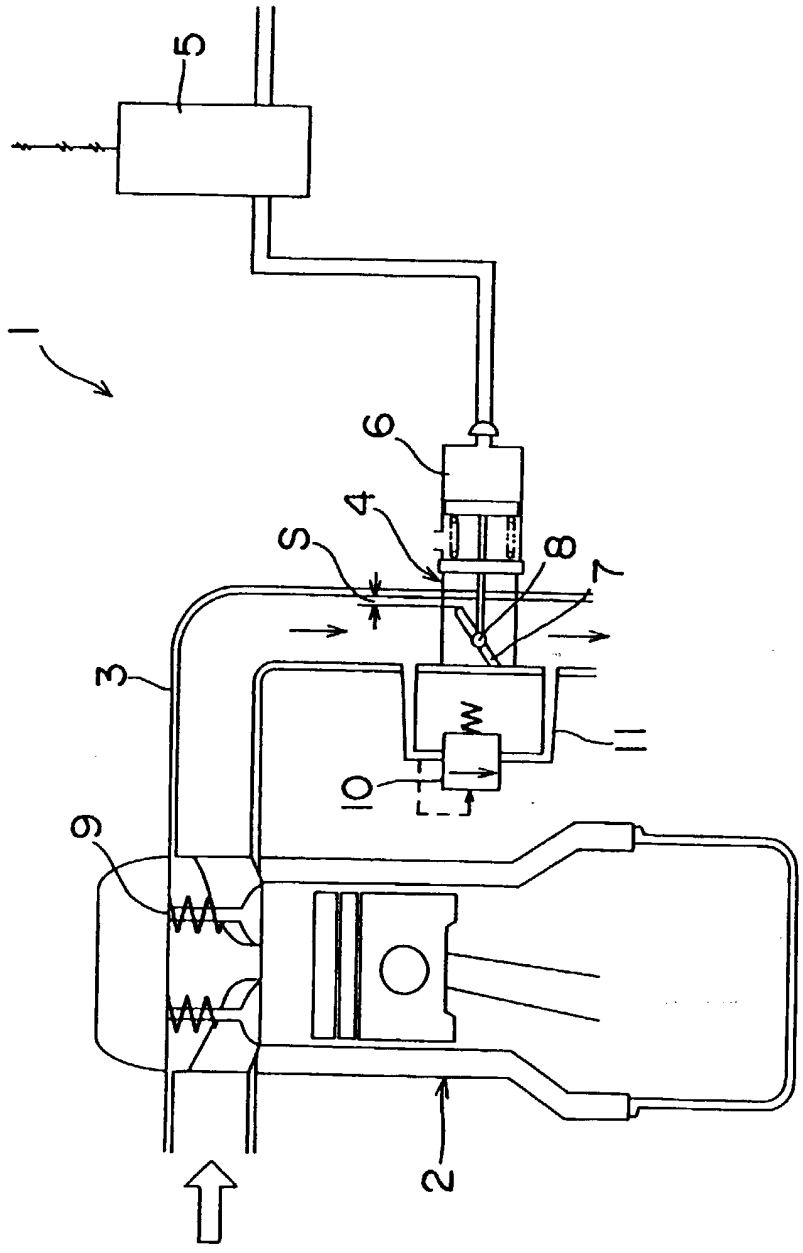
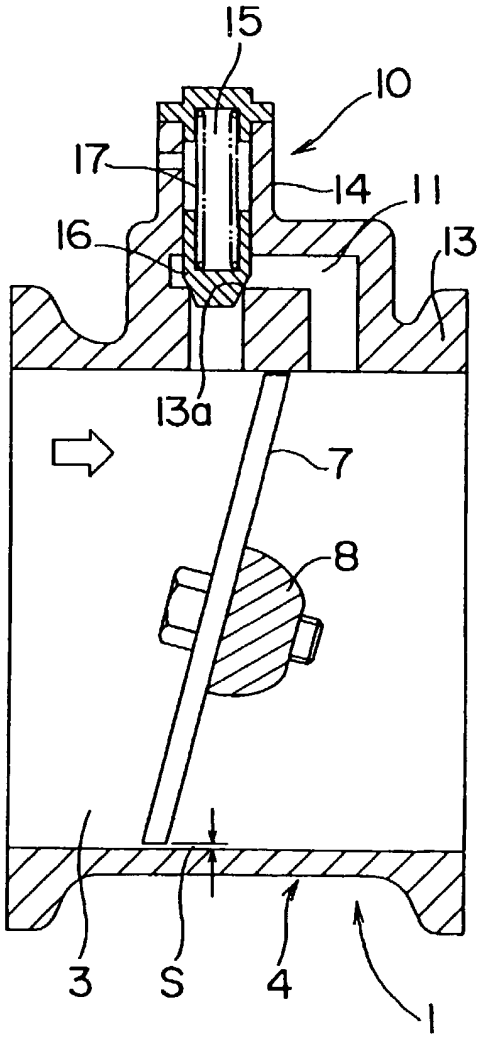


FIG.8



EXHAUST BRAKE APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an exhaust brake apparatus comprising a relief valve for releasing a pressure applied to upstream exhaust gas in an exhaust brake valve disposed in an exhaust pipe of an engine from upstream to downstream.

Description of the Prior Art

Fig. 7 is a schematic diagram of a construction showing a relationship between an exhaust brake apparatus and an engine. In an exhaust brake apparatus 1, an exhaust brake valve 4 is disposed in an exhaust pipe 3 of an engine 2. An electromagnetic valve 5 is turned on so that a fluid actuator 6 is actuated. A valve axis 8 of a butterfly brake valve body 7 is rotated so that the exhaust brake valve 4 is closed in order to operate a warming-up and an exhaust brake. An operation of the exhaust brake depends on an amount of a valve space S. Without a relief valve 10, the valve space S is set to a relatively large distance. However, where, since the relief valve 10 is installed, a brake power of the engine 2 is increased in a low and medium speed rotary zone. Accordingly, the valve space S is set to a small

distance. When the exhaust brake valve 4 is closed, if the engine 2 is rotated at high speed, a pressure of the exhaust pipe 3 rises. When the pressure is raised too high, an exhaust valve 9 is damaged. Accordingly, in order to prevent causing a damage, one part of exhaust gas can be released from upstream to downstream in the brake valve body 7 through a bypass path 11 of the relief valve 10.

Fig. 8 is a cross-sectional view showing a main portion of a conventional exhaust brake apparatus. In the exhaust brake apparatus 1, the same butterfly brake valve body 7 as described above is disposed in the exhaust pipe 3 of the engine 2. Further, the relief valve 10 is disposed in the exhaust brake apparatus 1. In the relief valve 10, a valve chamber 15 is formed in a relief valve box 14 integrated with a brake valve casing 13. A relief valve body 16 and a relief spring 17 are disposed in the valve chamber 15. The relief spring 17 disposed in the valve chamber 15 is energized in the direction of closing the relief valve body 16. A relief valve seat 13a is formed on a pipe wall integrated with the brake valve casing 13 and the exhaust pipe 3.

However, according to the exhaust brake apparatus 1 comprising the above conventional relief valve 10, the relief valve seat 13a is formed on a pipe wall integrated

with the brake valve casing 13 consisting of a spherical graphite cast iron material and the exhaust pipe 3. Accordingly, it is not possible to apply high hardness to the relief valve seat 13a. The relief valve seat 13a having lower hardness tends to be abraded. When the relief valve seat 13a is abraded, a pressured area of the relief valve body 16 becomes larger. Accordingly, when the valve is opened by lower relief pressure, there is a problem that the relief pressure is reduced so that the brake power is lowered.

Also, the relief spring 17 is subjected to high temperature exhaust gas in order to be deteriorated and degraded. Accordingly, a function as a spring is damaged. Further, metals are rubbed with each other on the surface slided between an outer periphery of the relief valve body 16 and an inside surface of the valve chamber 15. Accordingly, a sliding resistance is larger. Aside from this, there is another problem that a mutual slided surface is adhered due to an adhered carbon etc..

In view of the above conventional problems, it is an object of the present invention to provide an exhaust brake apparatus comprising a relief valve for obtaining a predetermined relief pressure. More especially, it is possible to easily apply hardness to a relief valve seat so that a relief valve body can be smoothly moved. A

relief spring is not subjected to exhaust gas in order to surely maintain a function as a spring of the relief spring.

SUMMARY OF THE INVENTION

In order to achieve the above object, according to one aspect of the invention, an exhaust brake apparatus having a relief valve for releasing a pressure applied to upstream exhaust gas in an exhaust brake valve disposed in an exhaust pipe of an engine from upstream to downstream comprises a seat member having another relief valve seat different from a brake valve casing of the exhaust brake valve, a relief valve body energized in a direction of the relief valve seat in order to be detachable relative to the relief valve seat of the seat member, wherein, a predetermined hardness is applied to the relief valve seat. According to another aspect of the invention, an exhaust brake apparatus of claim 1, comprises an energizing power adjustment mechanism for adjusting an energizing power in order to energize the relief valve body in the direction of the relief valve seat. According to further aspect of the invention, an exhaust brake apparatus of claim 1 or 2, wherein, the relief valve body integrated with a rod comprises an axis seal member for sealing an outer periphery of the rod so

that a relief spring energizing the relief valve body is accommodated in a spring chamber formed by isolating a flow-in of the exhaust gas.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional side view showing a main portion of an exhaust brake apparatus comprising a relief valve according to a first embodiment of the present invention.

Fig. 2 is a front view of Fig. 1.

Fig. 3 is a cross sectional side view showing the relief valve according to the first embodiment of the present invention.

Fig. 4 is a plan view showing the relief valve according to the first embodiment of the present invention.

Fig. 5 is a rear view showing the relief valve according to the first embodiment of the present invention.

Fig. 6 is a cross sectional side view of the relief valve according to a second embodiment of the present invention.

Fig. 7 is a schematic diagram of a construction showing a relationship between the exhaust brake apparatus and the engine.

Fig. 8 is a cross-sectional view showing a main portion of a conventional exhaust brake apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

Embodiments of the present invention are explained below in detail with reference to the drawings. Fig. 1 is a cross sectional side view showing a main portion of an exhaust brake apparatus having a relief valve according to a first embodiment of the present invention. Fig. 2 is a partially front view of a main portion of an exhaust brake apparatus having a relief valve according to the first embodiment of the present invention. The elements having the same reference numbers in Fig. 1 and Fig. 2 are the same portions in the conventional apparatus.

An exhaust brake apparatus 21 comprises another relief valve 24 different from a brake valve casing 23 of an exhaust brake valve 22. A seat member 28 having a relief valve seat 28a is disposed in a relief valve box 25. It is possible to easily apply hardness to the relief valve seat 28a. A relief valve body 29 is energized in the direction of the relief valve seat 28a by a relief spring 31. An energizing power adjustment mechanism 33 is installed so that a set load of the

relief spring 31, that is, an energizing power can be adjusted from outside in order to adjust a relief pressure. In the relief valve 24, the relief valve body 29 is integrated with a rod 29a. An axis seal member 30 is disposed in the relief valve box 25 so that an outer periphery of the rod 29a is sealed. Accordingly, exhaust gas can not be flowed into a spring chamber 32.

In the exhaust brake valve 22, an upstream relief hole 36 and a down stream link hole 37 in the brake valve body 7 are bored through a peripheral wall of the brake valve casing 23 straight along a radial direction. A flat reception surface 38 is formed on an outer surface of the brake valve casing 23 extended to the relief hole 36 and link hole 37. Further, in the exhaust brake valve 22, the relief valve box 25 is mounted to the brake valve casing 23 by a plurality of bolts 40 via an adiabatic gasket 39 relative to the reception surface 38. A fluid actuator 20 is operated so that the valve axis 8 is rotated in order to open and close the brake valve body 7.

Fig. 3 is a cross sectional side view showing a relief valve of a first embodiment of the present invention. Fig. 4 is a plan view thereof. Fig. 5 is a rear view thereof. The relief valve 24 comprises the relief valve box 25, a shell 26 mounted to the relief

valve box 25 by a plurality of bolts 41, and a cover 27 for closing an opening at the side opposite to the shell 26. The relief valve body 29 having the rod 29a is accommodated in an inside portion extended to the relief valve body 25 and the shell 26.

The relief valve box 25 is formed as a cylindrical shape having a rectangular section. When an intermediate inward flange 42 is defined as a border, a large diameter hole 43, an intermediate engaging hole 44 and a small diameter hole 45 following the large diameter hole 43 are disposed at the side of the cover 27. On the other hand, a bearing hole 46 is disposed at the side of the shell 26. A valve chamber 47 is formed by the small diameter hole 45. Also, in the relief valve box 25, a straight introduction hole 48 is linked to the large diameter hole 43 extended to the relief hole 36 of the brake valve casing 23. A slant deduction hole 49 is open at the position corresponding to the link hole 37.

An outward flange 51 is integrated with one end of the shell 26. An adjusting cylinder 52 is integrated with the other end of the shell 26. A female screw 52a is mounted to an inner periphery of the adjusting cylinder 52. The outward flange 51 is fitted to the end surface of the brake valve casing 23 via an adiabatic gasket 53. The shell 26 is attached to the relief valve

box 25 by a plurality of bolts 41. A retainer 54 faced with the adiabatic gasket 53 is accommodated in the shell 26. A spring adjusting member 55 is thread engaged with the adjusting cylinder 52.

A sintered alloy is used as the seat member 28. The sintered alloy consisted of Fe including Cr and Mo has excellent heat resistance and wear-and-abrasion resistance. A tapered bore-shaped relief valve seat 28a and a straight hole 28b following the relief valve seat 28a are open at the center of the seat member 28. Before installing the seat member 28, the seat member 28 is gas soft nitriding-treated or salt bath soft nitriding-treated. A Vickers hardness Hv is set to 1000 - 1200. The seat member 28 is forced into the engaging hole 44 in order to be caulked at a plurality of portions in the peripheral direction. Thereby, it is possible to prevent the seat member 28 from removing in order to be engaged with the relief valve body 25. When the hardness Hv of the seat member 28 is lower, the seat member 28 tends to be abraded. On the other hand, when the hardness Hv of the seat member 28 is too high, a toughness of the seat member 28 is lowered and changed to be brittle. In view of this, the above value is set.

A stainless steel (JIS mark: SUS440C) is gas soft nitriding-treated in order to be used as the relief valve

body 29. The hardness Hv is set to 1000 - 1200. The relief valve body 29 is integrated with the guided rod 29a and a small diameter end portion 29b. The rod 29a is sealed by the axis seal member 30. The rod 29a is supported by a bearing bush 60 in order to be detachable relative to the relief valve seat 28a. The small diameter end portion 29b is passed through the retainer 54 in order to be protruded into the spring chamber 32. The relief valve body 29 is energized in the direction of closing by relief spring 31.

The axis seal member 30 comprises an outer ring 58 consisting of a stainless steel (JIS mark: SUS403) and an inner ring 59 consisting of an expansion graphite engaged with an inner periphery of the outer ring 58. The axis seal member 30 is inserted between two portions in the bearing hole 46 intervening the bearing bush 60. A push member 61 prevents the axis seal member 30 from removing. Without the push member 61, it is possible to remove the axis seal member 30. In order to engage the axis seal member 30 with an outer periphery of the rod 29a, an inside dimension of the axis seal member 30 is formed in high accuracy as a press-formed product. The outer periphery of the rod 29a of the relief valve body 29 is sealed by the axis seal member 30. Thereby, it is possible to prevent exhaust gas in the valve chamber 47

from flowing into the spring chamber 32.

The relief spring 31 is disposed between the retainer 54 and a spring reception portion 64 of the spring adjusting member 55. The relief spring 31 is energized in the direction of closing the relief valve body 29 via the movable retainer 54 in the spring chamber 32. The spring chamber 32 is isolated from exhaust gas by the axis seal member 30 relative to the valve chamber 47. Accordingly, the relief spring 31 is not directly subject to high temperature exhaust gas in the spring chamber 32.

The energizing power adjustment mechanism 33 is constructed so that the spring adjusting member 55 is movably engaged with the adjusting cylinder 52. The spring adjusting member 55 is integrated with the intermediate spring reception portion 64, a long stopper 65 whose edge surface is faced to the end surface of the small diameter end portion 29b, and a male screw portion 66. The male screw 66 is engaged with the female screw 52a on an inside surface of the adjusting cylinder 52. The spring adjusting member 55 is mounted to the adjusting cylinder 52 of the shell 26. The spring adjusting member 55 is positioned by a nut 67 engaged with an outer end of the male screw portion 66.

The spring adjusting member 55 is rotated so that

the energizing power adjustment mechanism 33 adjusts a position of the stopper 65. When the engine is resonated, a deflection of the relief valve body 29 is restricted by the energizing power adjustment mechanism 33. Further, simultaneously, it is possible to adjust a relief pressure according to the relief spring 31.

An operation of an exhaust brake apparatus according to a first embodiment of the present invention is explained below. The fluid actuator 20 is inoperative, the exhaust brake valve 22 is open. In this condition, when the exhaust brake is necessary, the fluid actuator 20 is actuated so that the exhaust brake valve 22 is closed. In this condition, when a car continues to run down on a downward slope, an engine speed is increased so that an exhaust pressure of an upstream exhaust gas G in the exhaust brake valve 22 rises in the exhaust pipe. The exhaust pressure is acted to the exhaust brake valve 22 as a back pressure.

However, the relief valve 24 is installed in the exhaust brake apparatus of the present invention. Accordingly, when the exhaust pressure reaches to more than a set pressure, the relief valve body 29 is detached from the valve seat 28a against the engaging power of the relief spring 31. Thereby, one part of the exhaust pressure is flowed downward through the relief hole 36,

the introduction hole 48, the valve chamber 47, the deduction hole 49 and the link hole 37. As a result, even if, when the car is running on the downward slope, the engine speed is increased so that the upstream exhaust pressure is raised, the exhaust brake valve 22 remains closed so that the upstream of the exhaust brake valve 22 is linked to the downstream thereof. Accordingly, the exhaust pressure is constantly held so that the excessive rise of the exhaust pressure is controlled in order to prevent stopping the engine.

According to the first embodiment of the present invention, the energizing power adjustment mechanism 33 is installed. Accordingly, the spring adjusting member 55 is rotated so that the set load of the relief spring 31 is adjusted from outside. Thereby, a dispersion of the relief pressure due to the dispersion of the set load is not occurred. The two axis seal members 30 are disposed so that the outer periphery of the rod 29a in the relief valve body 29 is double sealed. Thereby, there is an advantage that it is possible to surely prevent the exhaust gas in the valve chamber 47 from flowing into the spring chamber 32. Also, the relief valve box 25 and the shell 26 are mounted with the adiabatic gaskets 39 and 53 inserted between, respectively. Accordingly, it is possible to prevent the

rise of temperature due to exhaust gas in the valve chamber 32.

Embodiment 2

Fig. 6 is a longitudinal sectional view of the relief valve for the exhaust brake apparatus according to the second embodiment of the present invention. In the relief valve 24, a concave ring 25a is protruded on the relief valve box 25. The cover 27 is forced into the seat hole 25b formed in the relief valve box 25 so that a plurality of portions are caulked in order to prevent removing. The seat member 28 is forced into the engaging hole 44 in order to be caulked by a fixing ring 70. The axis seal member 30 and the bearing bush 60 are disposed so that the deduction hole 49 is not slanted.

Also, in the relief valve 24, an engine exhaust valve is used so that a seat surface thereof is worked at the opposite side. Thereby, the relief valve body 29 is formed by the worked product. An annular groove 29c is formed in a portion of the rod 29a protruded into the spring chamber 32. The retainer 54 is mounted to the rod 29a via a double-split cotter 71 having a concave bar 71a entered into the annular groove 29c. The shell 26 is engaged with the outer periphery of the concave ring 25a. The above portions are different from the first embodiment. The other rest portions are almost similar

to the first embodiment. The elements having the same reference number in the second embodiment are the same portions in the first embodiment. Accordingly, an explanation of the same portions is omitted.

The present invention is not restricted to the above embodiments. Different variations and deformations can be applied within the scope of claims described below. For example, a seat hole is installed at the brake valve casing 23 so that the seat member 28 can be engaged with the seat hole. Aside from the above examples, a material having a heat resistance, and a wear and abrasion resistance may be used as a material of the seat member 28. In stead of an expansion graphite, other materials may be used as a material of the axis seal member.

An exhaust brake apparatus of the present invention comprises a seat member having another relief valve seat different from a brake valve casing of the exhaust brake valve. Thereby, a predetermined hardness is applied to the relief valve seat. Accordingly, the hardness is applied to the relief valve seat in order to prevent abrasion. There is caused an effect that it is possible to surely maintain a function as a spring of a relief spring in order to obtain a predetermined relief pressure. Also, an energizing power adjustment mechanism is installed in order to adjust an energizing power so

that the relief valve body is energized in the direction of the relief valve seat. Thereby, the relief valve body can be smoothly moved so that it is possible to surely obtain a predetermined relief pressure. Further, the relief valve body is integrated with a rod. An axis seal member for sealing an outer periphery of the rod is installed in the relief valve body. A relief spring energizing the relief valve body is accommodated in a spring chamber formed by isolating a flow-in of the exhaust gas. Accordingly, the relief spring is not subject to exhaust gas so that it is possible to maintain a stable relief pressure over a long period.

What is claimed is :

1. An exhaust brake apparatus having a relief valve for releasing a pressure applied to upstream exhaust gas in an exhaust brake valve disposed in an exhaust pipe of an engine from upstream to downstream, comprising:

a seat member having another relief alve seat different from a brake valve casing of said exhaust brake valve; and

a relief valve body energized in a direction of the relief valve seat in order to be detachable relative to the relief valve seat of the seat member,

wherein, a predetermined hardness is applied to said relief valve seat.

2. An exhaust brake apparatus of claim 1, comprising an energizing power adjustment mechanism for adjusting an energizing power in order to energize said relief valve body in the direction of the relief valve seat.

3. An exhaust brake apparatus of claim 1 or 2, wherein, said relief valve body integrated with a rod comprises an axis seal member for sealing an outer periphery of the rod so that a relief spring energizing said relief valve body is accommodated in a spring chamber formed by isolating a flow-in of the exhaust gas.

4. An exhaust brake apparatus having a relief valve for releasing a pressure applied to upstream exhaust gas in an exhaust brake valve disposed in an exhaust pipe of an engine from upstream to downstream, comprising:

a seat member having a valve seat of a different material from a material of a brake valve casing of said exhaust brake valve; and

a relief valve body energized in a direction of the relief valve seat in order to be detachable relative to the relief valve seat of the seat member.

5. An exhaust brake apparatus of claim 4, comprising an energizing power adjustment mechanism for adjusting an energizing power in order to energize said relief valve body in the direction of the relief valve seat.

6. An exhaust brake apparatus of claim 1 or 2 or 4 or 5 wherein, said relief valve body is integrated with a rod and comprises an axis seal member for sealing an outer periphery of the rod so that a relief spring energizing said relief valve body is accommodated in a spring chamber isolated from the exhaust gas.

7. An exhaust brake apparatus of any one preceding claim wherein said seat member is made of a sintered alloy comprising iron, chromium and molybdenum.

8. An exhaust brake apparatus of claim 7 wherein said seat member has a nitrided surface layer.

9. An exhaust brake apparatus of any one preceding claim wherein the relief valve body is made of a stainless steel material.

10. An exhaust brake apparatus of any one preceding claim wherein the hardness of the valve seat of said valve seat member has a hardness lying in the range from 1000 to 1200 H_v.

11. An exhaust brake apparatus of any one preceding claim from 3 to 10 where the axis seal member comprises expanded graphite.

12. An exhaust brake apparatus of any one preceding claim where the valve seat member is retained in position by an interference fit.

13. An exhaust brake apparatus of any one preceding claim where the valve seat member is provided with a retaining fixing ring.

14. An exhaust brake apparatus having a relief valve for releasing a pressure applied to upstream exhaust gas in an exhaust brake valve disposed in an exhaust pipe of an engine from upstream to downstream substantially as hereinbefore described with reference to the accompanying description and to Figures 1 to 5 and 7; or Figure 6 of the drawings.

The Patent Office

Application No:	GB 9624533.7	**Examiner:**	Ken Strachan
Claims searched:	All	**Date of search:**	13 February 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F1B: BBA, BBC, BBD, BBE, BBG;

Int Cl (Ed.6): F02D: 9/00, 9/04, 9/06, 9/08, 9/10, 9/12, 9/14, 9/16, 9/18;

Other: Online databases: WPI; EDOC.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	JP8-261022	(Jidosha Kiki) See figure 1; notice exhaust brake 5, relief valve 36 mounted remotely from brake valve casing 4.	
X Y	US 5,435,347	(Donaldson) See figs. 1 and 2; notice main brake tube 80, adjustable relief valve 40.	X: 1, 2, 4, 5, at least. Y: 3, 6, at least.
Y	US 4,682,674	(Scmidt) See figure 1; notice axis seal member 15 for adjustable relief valve.	3, 6, at least.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.